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TABLE OF CONTENTS

Management Strategies for Records and Archival Documents For Documentation in The Digital /Artificial Intelligence Age Faculty Education Registry Staff Ahmadu Bello University, Zaria Nigeria	1-12
<i>Mohammed Abubakar Abdullahi, Aliyu Abubakar, Abdulmumini Shehu</i>	
Access to Digital Library as A Panacea for Knowledge Sharing in Academic Libraries.....	13-17
<i>Aminu Saleh, Joan Adamu Joshua, Fatimah Sani, Abdullahi Abubakar Dewa, Dr. Henry Maina Abareh</i>	
Adoption of web 3.0 For Easy Access to Digital Information Resources and Services In Federal University Library Lokoja, Kogi State Nigeria.	18-30
<i>Fwenshimwa G. Yaima. Fatima S. Ibrahim, Prof. Ezra S. Gbaje</i>	
Use of Digital Artificial Intelligence for Management and Use of Records and Archival Documents for Documentation in the School of Postgraduate Studies, (SPGS) Ahmadu Bello University, Zaria Nigeria.....	31-44
<i>Abdulmumini Shehu, ASMAU Muhammad Yusuf</i>	
Use of Artificial Intelligence in Academic Library Services in Federal College Of Education Zaria, Kaduna State.....	45-52
<i>Abdullahi Jibril, Raji Basirat</i>	
Exploring The Potential of Artificial Intelligence In Information Retrieval In Libraries.....	53-58
<i>Sakinat Ja'afar, Rahinatu Mohammed, Dr. Aliyu Ahmed</i>	
Effect of Management Information System (Mis) Utilization for Transport Data Systems In Nigerian Institute Of Transport Technology (Nitt), Zaria.....	59-63
<i>Yusuf Ishaq, Jamila Yakubu, Umar Zainab</i>	
Information Perspective of Artificial Intelligence Tools for Administration of Islamic Law of Inheritance In Sharia Courts In Nigeria.....	64-71
<i>Dr Aliyu Ahmad, Bilkisu Lawal</i>	
Ensuring Interoperability and Discovery of Metadata Standards for Digital Libraries.....	72-78
<i>DR. Yusuf Ahmed, MAIFATA Nurudeen Mu'azu, Moses, Ishaya</i>	
Personalizing Librarian's Portfolio for Continuing Professional Development and Responsive Service Delivery In Digital Enabled Revolution.....	79-86
<i>Kasa, M. Gabriel & Adedokun, A. O.</i>	
Roaming Readers: Unraveling Library Services for Nomadic Communities– A Rajasthan Case Study at the Government Divisional Public Library, Kota.....	87-95
<i>Dr. Haruna, Musfapha, Dr. Deepak Kumar Shrivastava, Abba, Hamza</i>	

Utilization of Management Information System (Mis) for Transport Data Systems In Nigerian Institute of Transport Technology (Nitt), Zaria.....	96-101
Safiya Mohammed Saleh & Sani Murtala Ridwan PhD	
Application of health beliefs model to enhance women's knowledge of preterm birth information for safe delivery in sub-saharan africa: a scoping review.....	1012-110
Uche, S. C., Ibinaiye, I. D. PhD, Jibrin, A PhD	
The Relevance and Challenges of Ict Smart Technologies In Urban Household Energy Poverty Vulnerability Research In Global North and South: A Conceptual Review.....	111-118
U.A Anka	
Unlocking Knowledge and Scholarship Via Digitization	129-124
Kasa, M. Gabriel & Bello Yerima	
Application of Semantic Web Technologies On Enhancing Cataloguing And Classification Practices In Digital Libraries.....	125-132
Yaya Usman, Bakari Sadiku Umar, Sani Asiya	
Assessment of Problems from Development In Sub-Saharan Africa: A Case Study of Nigeria.....	133-143
Chinomso Chinazaekperem Okoro & Dr. Ibrahim Dogara	
An Assessment of Online Facilitation Processes In The Distance Learning Centre Of Ahmadu Bello University, Zaria.....	144-154
Mohammed Ya'u, Dr. Ibrahim Salihu Yusuf	
Health Hazard Information Sharing From Telecommunication Mast Exposure: A Scoping Review Applying Theory Of Information Interchange.....	155-166
Abdulkadir Tanko ISAH, Ibinaiye, I. D. PhD, Jibrin, A PhD	
Adoption Of Electronic Medical Record System (Emrs) In Some Selected Federal University Teaching Hospitals In North West States Of Nigeria.....	167-179
Sambo Suleiman, PhD, Mohammed Habibu. PhD	
Utilization of Telemedicine By Medical Professionals In Some Selected Hospitals In Zaria Metropolis Kaduna State Nigeria.....	180-189
Sambo Suleiman, PhD & Babangida U. Dangani PhD	
The Rise of Machines, Bridging Sense and The Nonsense Of Artificial Intelligence In Developing Nations' Libraries.....	190-199
Ogbonyomi, Abel Adegoke, Amata S. Bello, Takai Grace	
Challenges To The Utilization Of E-Library Services By Students Of Fudma During A 2-Day Nigerian Labour Congress Warning Strike.....	200-206
Felix, Usman Manjack CLN, Ukashatu Hamza Musa PhD, and Hassan Usman PhD	

Integrated Library System (ILS) Skills Of Librarians For Accessibility Of Resources.....	207-216
GOSHIE, Rhoda Wusa, JIMOH, Amina Oiza, JIMADA, Aisha	
An Assessment of Online Facilitation Processes In The Distance Learning Centre of Ahmadu Bello University, Zaria	217-227
Mohammed Ya'u, Dr. Ibrahim Salihu Yusuf	
Types of digital literacy skills for accessing tradermonI scheme information by the beneficiaries in north east states of Nigeria.....	228-234
Adamu Samuel, Zakari Mohammed, Habibu Mohammed & Babangida Umar Dangani	
Challenges Of Shari'a Courts Records Management For Dispensation Of Justice In Kaduna State Shari'a Courts.....	235-242
Dr. Abdulhamid Liman Gambo	
Application of Information Governance Accountability Principle For Quality Service Delivery In Faculty Of sEducation, Ahmadu Bello University, Zaria.....	243-248
SANUSI, Aliyu Babalola, ABDULRAHIM, Abdulfatah & ABUBAKAR, Aliyu Dauda.	
Embracing The Digital Renaissance: Future-Proofing Ahmadu Bello University Library Complex.....	249-251
Ms Alice Mousonda Mwape	

EXPLORING THE POTENTIAL OF ARTIFICIAL INTELLIGENCE IN INFORMATION RETRIEVAL IN LIBRARIES

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Abstracts

This paper discussed the impact of artificial intelligence in Information Retrieval (IR). It also explains the types of information retrieval and some specific AI-powered IR tools and highlights their significance. Information Retrieval (IR) is a field driven by the need for efficient access to vast amounts of information. It has evolved through different generations, from manual categorization to advanced AI-driven tools in the fourth generation. IR systems aim to store, retrieve, and maintain various types of information, including textual, visual, auditory, and multimedia data. These systems serve different objectives, with academia focusing on research and commercial institutions prioritizing practicality. Various types of IR approaches include keyword-based retrieval, Boolean retrieval, probabilistic retrieval, vector space models. Artificial Intelligence (AI) plays a significant role in IR by enhancing search precision, providing personalized results, and expanding the scope of content types retrieved. AI has the potential to revolutionize various industries and poses both opportunities and ethical concerns. AI-powered IR tools, such as Elicit, Consensus, Keenious, Litmaps, Poe-fast, and Scispace, are transforming the way information retrieval is conducted. These tools use AI algorithms to improve efficiency and accuracy, offer personalized recommendations, automate cataloging, and provide instant user support. The text highlights the challenges in IR, including ambiguous queries, relevance and ranking, information overload. Researchers and developers continuously work to address these challenges through innovative approaches and evaluation metrics. Overall, AI is reshaping the landscape of information retrieval, making it more efficient, personalized, and capable of handling diverse content types.

Keywords: Information Retrieval, Artificial Intelligence

Introduction

The initial advancements in information retrieval can be attributed to the growing demand for access to extensive amounts of information. Consequently, the creation of document collection structures became imperative in order to facilitate faster access to information resources. The index emerged as the preferred document structure for expedited retrieval of information. Historically, manual categorization of hierarchies was employed for indexing, with libraries being the first institutions to embrace information retrieval systems. The first-generation systems entailed the automation of previous technologies, primarily relying on

author names and titles for search queries. Subsequently, the second generation introduced additional search criteria such as subject headings and keywords. The third generation witnessed the incorporation of graphical interfaces, electronic forms, hypertext features, and more. Presently, we find ourselves in the fourth generation of information retrieval, wherein artificial intelligence-driven tools like *elicit.org*, *consensus*, *keenious*, and *litmaps* play a pivotal role.

According to Baeza-Yates & Ribeiro-Neto (2011), Information retrieval (IR) is the science of searching for information in documents, searching for documents themselves, searching for metadata that describes documents, or searching within databases, whether relational stand-alone databases or hypertext networked databases such as the Web or intranets, for text, sound, images, or data. An Information Retrieval System can be defined as a system that possesses the ability to store, retrieve, and maintain information. Within this particular context, information is comprised of textual content (including numerical and temporal data), visual representations, auditory elements, video recordings, as well as various other forms of multimedia entities

The primary goals of an Information Retrieval System (IRS) are to efficiently deliver information to the user while minimizing both time and effort, serve as an intermediary between the user and the information, produce unambiguous search results through meticulous indexing, and possess a user-friendly interface. Information retrieval can be conceptualized as a software application that manages the organization, storage, retrieval, and assessment of information obtained from collections of documents, particularly those that contain textual content. Information Retrieval refers to the process of acquiring materials, typically in an unstructured format, such as text, that fulfill an information requirement by searching through vast computer-stored collections. An instance of Information Retrieval can occur when a user submits a query into the system.

Types of information retrieval and the potential of artificial intelligence tools

Information retrieval is a field that involves searching for relevant information within a collection of documents. It encompasses the process of acquiring pertinent information from a compilation of data or documents. Various approaches and techniques exist in the realm of information retrieval. AI-powered Information Retrieval tools are revolutionizing the way university libraries operate and transforming the services they offer. These tools use AI algorithms to enhance the efficiency and accuracy of information retrieval, saving valuable time and improving the overall user experience. By analyzing vast amounts of data and user behavior, AI systems can generate more relevant search results, helping students and researchers find the resources they need quickly and efficiently.

Additionally, AI algorithms can analyze user preferences, browsing history, and academic interests to provide personalized recommendations for books, articles, and research papers. This personalized approach enables students and researchers to discover new resources and explore topics they may not have considered otherwise, promoting a culture of continuous learning and intellectual growth. AI technologies, such as natural language processing and machine vision, also enable libraries to automate cataloging processes, digitize materials, and organize information effectively. This streamlines administrative tasks and improves accessibility to resources, making them available to a wider audience. Presented below are some widely recognized types:

1. **Keyword-Based Retrieval:** This fundamental form of information retrieval involves users inputting keywords or search terms, which subsequently prompts the system to retrieve documents containing those specific keywords. Prominent examples of this approach include search engines such as Google or Bing. **Elicit: AI-powered IR Tool** *Elicit.org* is an academic search engine that utilizes the power of state-of-the-art Large Language Models

(LLMs) to enhance the search experience. It was one of the first academic search engines to experiment with this technology, making it a pioneer in the field. Compared to other similar tools, Elicit.org stands out with its polished features and user-friendly interface. However, it is important to exercise caution when using LLMs for information retrieval, as their answers may not always be reliable. Elicit.org addresses this concern by highlighting the text used to generate the answers, making it easier for users to verify the information. In the past, it was believed that AI was better suited for data-driven tasks rather than cognitive and creative ones. However, recent advancements in natural language processing (NLP) have challenged this notion. NLP focuses on how computers can process language like humans, and it has made significant strides in areas such as writing and programming. One of the most well-known NLP tools is GPT-3, developed by OpenAI. GPT-3 can perform tasks like classifying documents, answering questions, and summarizing reports.

2. Boolean Retrieval: Akin to Boolean logic, this approach employs operators like "AND," "OR," and "NOT" to merge search terms. It empowers users to refine their queries by specifying relationships between keywords. **Consensus: AI-powered IR tool.** Consensus is an AI-powered search engine that helps you find evidence-based answers from scientific research. It uses artificial intelligence to extract and summarize key findings from research papers, making it easier for you to conduct effective research. Unlike other search engines that show ads and prioritize revenue-generating results, Consensus only provides results from published, scientific sources. It aims to democratize expert knowledge and make scientific research accessible to everyone. Consensus AI works by using natural language processing, machine learning, and blockchain technology to analyze and evaluate web content. It reads articles and extracts relevant information that answers your question. Each discovery is supported by a confidence level that reflects the number and quality of sources backing it up, ensuring reliable and trustworthy answers. You can search for a wide range of topics, from biology to sociology, and tailor your search to your specific needs. Consensus AI is a versatile tool for various academic fields. Using Consensus AI offers several benefits for your research process. It provides scientifically verified results by consulting previously published, scholarly works. With access to a vast database of 400 million scholarly articles, you can find a wide range of information for your research. The search engine is fast and reliable, allowing you to get evidence-based answers quickly and easily.

3. Probabilistic Retrieval: This approach takes into consideration the probability of a document's relevance to a given query. It allocates weights or scores to documents based on the likelihood of their relevance. The Okapi BM25 algorithm stands as one of the most renowned probabilistic retrieval models. **Keenious AI-powered IR tool:** Keenious is an AI-powered information retrieval tool that can help researchers find relevant articles and topics to enhance their research process. It was founded in 2017 by researchers who wanted to solve the problem of finding relevant sources for a specific research topic. Keenious is available to all members of the CMU community and is the first university in the United States to implement this innovative tool. It uses search algorithms and AI to analyze text and recommend research articles and topics from over 200 million publications. Keenious can be accessed through a web interface or as a plugin for Microsoft Word and Google Docs. It seamlessly integrates with library subscriptions and open access sources to make accessing full text content easier. When CMU users sign up for a free Keenious account using their CMU email address, they will automatically gain access to the library's resources. Keenious offers various features to empower research, such as the ability to filter searches, focus searches on specific sections of text, save article results, and export citations. It also provides a highlight search feature, where users can highlight important sections of a document and receive tailored research recommendations.

4. Vector Space Model: This model represents documents and queries as vectors within a multi-dimensional space. Each dimension corresponds to a term, while the vector's magnitude and direction indicate the term's importance. Similarity measures, such as cosine similarity, are employed to rank documents based on their proximity to the query vector. **Scispace AI powered tool:** it is an incredible AI powered tool to help you understand research papers better. It can explain and elaborate most academic texts in simple words. **Litmaps: AI Powered IR Tool:** Litmaps is an AI-powered information retrieval tool that simplifies and streamlines the process of literature reviews. With Litmaps, you can save time and enhance the quality of your literature review with unmatched accuracy and efficiency. Using a single seed paper, Litmaps generates a visually appealing map that showcases the most relevant articles in relation to the initial document. The map is organized in a user-friendly manner, with the most recent articles on the right and the most cited ones at the top. Citations are represented through connecting lines between various articles on the map. This unique feature allows you to easily trace citation connections and explore the literature in a more interactive way. Litmaps offers several key features to optimize your research experience. Firstly, you can effortlessly uncover essential academic papers through automated citation searching. This saves you the hassle of manually searching for relevant articles. Secondly, you can view your search results in an interactive Litmap, which allows you to visualize the citation connections between articles. This helps you understand the relationships between different papers and identify key sources for your literature review.

5. Natural Language Processing (NLP)-based Retrieval: This approach leverages NLP techniques to process and comprehend natural language queries. Its objective is to bridge the gap between human language and machine-understandable representations to augment retrieval effectiveness. **Poe-fast AI chat powered tool** is a platform that lets people ask questions, get instant answers, and have back-and-forth conversations with a wide variety of AI-powered bots. It is available on iOS, Android, MacOS and web. Traditional search engines and databases often rely on keyword-based searches, which can be limiting and may not always yield the most relevant results. AI powered search tools, on the other hand, can analyze the content of library materials and understand the context in which they are written, making it possible to retrieve information based on the meaning and intent behind a user's query. This can lead to more accurate and relevant search results, ultimately improving the user experience. (Marcin , 2023)

Significance of artificial intelligence in information retrieval

Artificial Intelligence (AI) plays a significant role in the domain of information retrieval, thereby altering the manner in which we conduct searches for and gain access to information. By comprehending the intent and context of the user, it has enhanced the precision of search outcomes. This is achieved through the utilization of Natural Language Processing (NLP) and machine learning methodologies, which facilitate the analysis of query semantics, thereby ensuring the provision of more pertinent results. Consequently, the probability of encountering irrelevant or extraneous information is reduced. Moreover, the personalization of search results, based on the preferences, behavior, and historical activities of the user, has been influenced by the analysis of the user's past searches and interactions. This has resulted in the facilitation of tailored recommendations and content, thereby rendering information retrieval more efficient and user-friendly. Furthermore, the realm of information retrieval has been expanded by artificial intelligence to encompass not only textual information, but also visual and auditory content. The capabilities of image recognition and speech-to-text conversion enable AI systems to explore content in diverse formats, thereby ensuring a more comprehensive approach to information retrieval.

Artificial intelligence (AI) plays a significant role in the realm of information retrieval (IR) by employing AI methodologies to account for the inherent uncertainty and imprecision

within this task (Shukla, Singh, Prashant, Johri, Avncesh, & Kumar 2022). By automating repetitive and time-consuming retrieval tasks, AI systems alleviate the workload on analysts and enable them to concentrate on analysis (Boughanem, Akermi, Pasi, Abdulahhad 2020). AI technologies are utilized to identify and arrange records within a database, delivering pertinent information to users (Hepenstal, Zhang, Kodogoda, William & Wong 2020). Techniques originating from AI, such as similarity functions, are employed to accurately represent and align documents within IR (Bilger, Jeffrey & Matthew 2020). The interplay between IR and AI is explored, highlighting the application of AI methodologies within IR systems (Thomas, 2009). On the whole, AI enhances the efficiency and efficacy of information retrieval processes, thereby contributing to knowledge management and addressing ethical concerns.

Challenges of information retrieval

Information retrieval (IR) is a complex field with various challenges and issues that researchers and developers continually face. Some of the most significant challenges include:

1. **Ambiguity of Queries:** Queries submitted by users can be vague, imprecise, or ambiguous. Understanding the user's intent and translating it into an effective search is a significant challenge in IR.
2. **Relevance and Ranking:** Determining the relevance of documents to a given query is a subjective task, and different users may have different notions of relevance. Developing effective ranking algorithms that accurately prioritize relevant documents is an ongoing challenge.
3. **Information Overload:** The exponential growth of digital information has led to information overload. Users are inundated with an overwhelming number of search results, making it difficult to find the most relevant information quickly.
4. **Language and Multilingualism:** IR systems need to support queries and documents in multiple languages. Handling language-specific nuances, cross-lingual retrieval, and translation challenges present difficulties in building multilingual IR systems.
5. **User Context and Personalization:** Tailoring search results to individual users based on their preferences, history, and context is a challenging task. Personalized IR aims to deliver more relevant results but requires addressing privacy concerns and avoiding filter bubbles.

Conclusion

In conclusion, this paper explores the domain of Information Retrieval (IR) and its intersection with Artificial Intelligence (AI). It delves into the evolution of IR, starting from its rudimentary stages of manual classification to the advanced tools of the fourth generation powered by AI. IR serves a variety of objectives, with academia focusing on research while commercial institutions prioritize practicality. The paper underscores the challenges encountered in IR, which encompass ambiguous queries, issues of relevance and ranking, information overload, multilingualism, user personalization, spam, data heterogeneity, and bias. Researchers and developers continuously strive to address these challenges through innovative approaches and evaluation metrics. In summary,

Way forward

Various types of IR approaches are examined to see how artificial intelligence tool will help in information retrieval, such as keyword-based retrieval, Boolean retrieval, probabilistic retrieval, vector space models and NLP-based retrieval. The role of AI in IR is emphasized, highlighting its potential to enhance search precision, provide personalized results, and broaden the range of retrieved content types. AI-powered IR tools, such as Elicit, Consensus, Keenious, Litmaps, Poe-fast, and Scispace, are revolutionizing the field by automating cataloging, offering personalized recommendations, and improving efficiency and accuracy. AI is reshaping the landscape of information retrieval, rendering it more efficient,

personalized, and skilled in handling various content types. Information retrieval, empowered by AI, is poised to play a pivotal role in transforming how we access and utilize vast volumes of information, presenting both opportunities and ethical concerns for the future.

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